The Rural Broadband Imperative
Fiber for the New Economy
Minneapolis 2016

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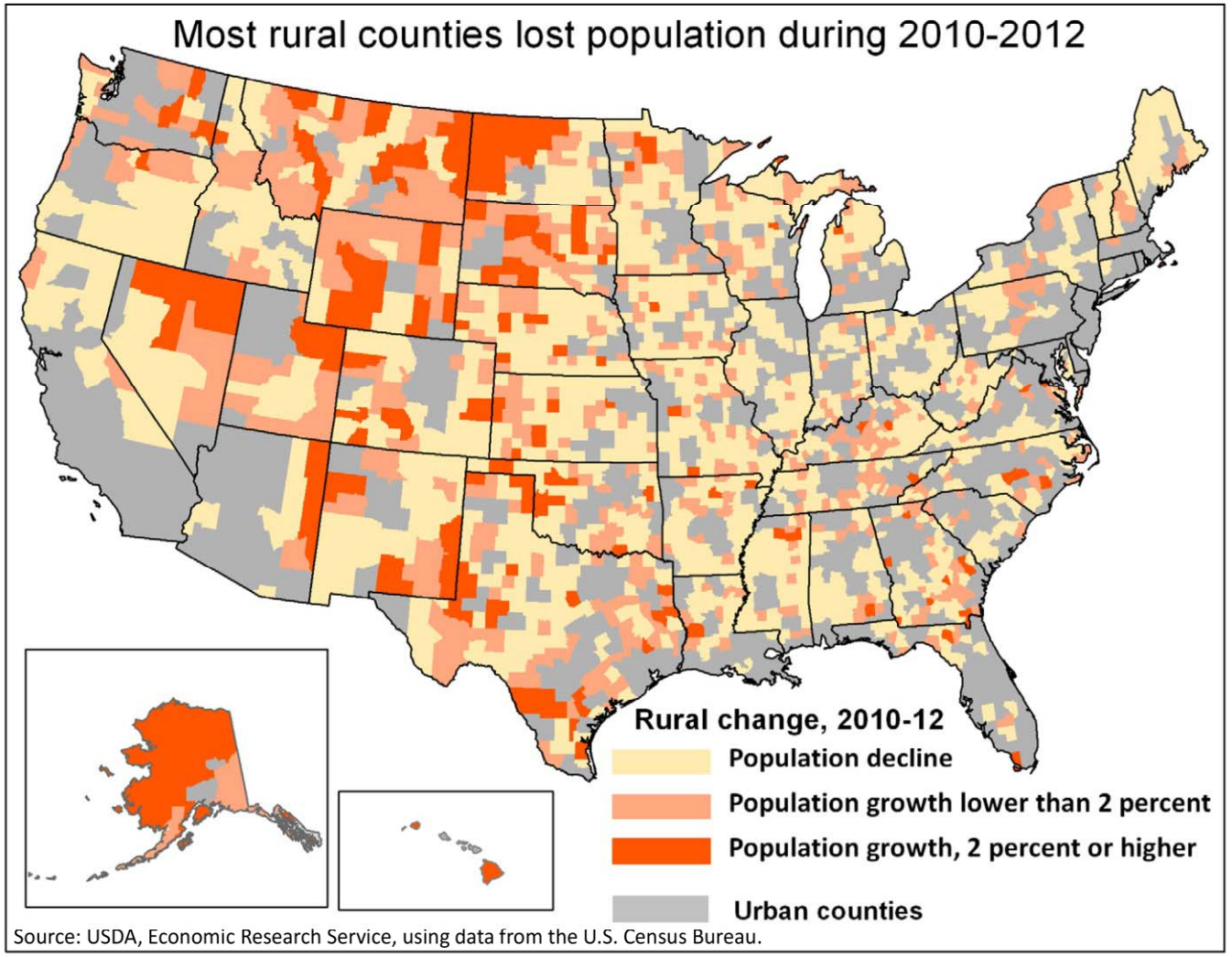
The FCC and White House want to change the broadband business plan

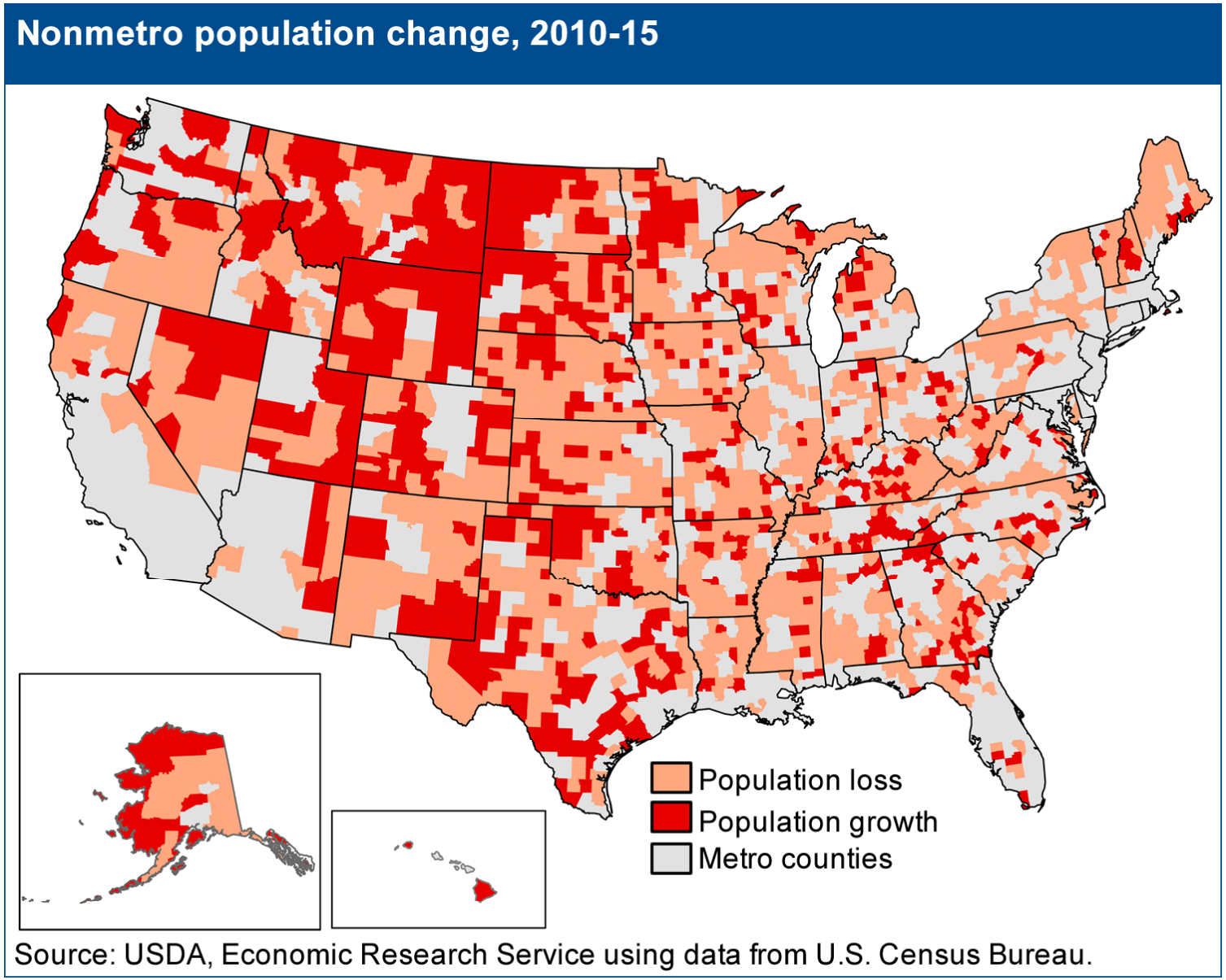
- More rural broadband
- More opportunity for municipal or public-private partnership broadband
- More profits for big content players like Google and Netflix
- Less flexibility for big carriers

Why is this happening?
Will it help or hurt smaller carriers?
Rural communities?
Content providers?

For the first time in American history…



And rural population loss has continued



This matters to everyone

- We at the magazine care, because fewer broadband systems get built.
- OECD says digital divides from any cause reduce overall GDP in countries that have divides. This means fewer jobs, fewer opportunities.
- In the USA, rural financial institutions weaken as property values decline; conversely, fast growing communities suffer congestion, inflation, and the need to expand infrastructure. Nationally (but not everywhere) this effect is small – in a rural county, typical population loss is small compared to urban gain in absolute numbers.

Methodology

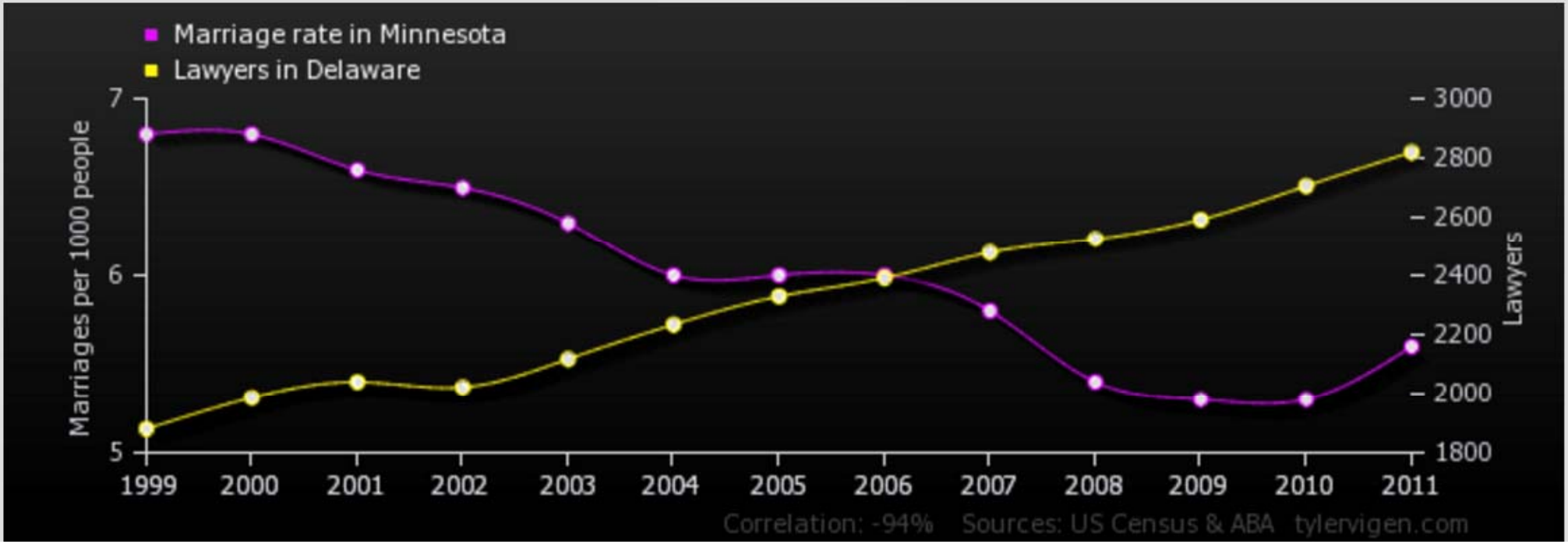
- Looked at all 3144 counties in 50 states and DC.
- Matched National Broadband Map data for 25x3 Mbps access with Census population data through the end of 2013 and USDA data on each county's dominant activities. State-by-state rankings of each county are generated by the NBM
- Population change is surrogate for economic change, especially job growth or decline.
- Census data have county-by-county confidence intervals for most counties, allowing good statistical check on population.
- Called more than 50 rural mayors, economic development administrators, activists (see also Nov-Dec 2014 issue for case studies on what specific communities are doing).
- Adding premises data from USGS digital maps.

Confounders

- **Chicken-and-egg**; is population declining because (in part) of poor broadband, or is poor broadband the result of lousy business case due to population decline? Or some "outside" influences, unknown or unexplored?
- **States have very different ways of dividing themselves into counties**. Texas alone has almost 10% of all US counties.
- **States vary in other ways.** States have different population densities, distributions, temporary economic advantages (new oil discoveries, retiree attraction…). Also, states with restrictions have different kinds, enacted at different times.
- **Very small-population-counties** Can move the gauge needle with just one new business or housing development.
- **Moves not always intra-state**. People tend to migrate for work as short a distance as possible, but could move to nearby state, softening the link between rural decline and urban growth in a given state.
- **25 Mbps** is the FCC's new threshold for "broadband," but that level is somewhat arbitrary.
- **Variance on X-Axis.** National Broadband Map data are flaky and tend to over-estimate actual access
- **Take rate variance.** Even in counties with great 25 Mbps access, less than 30% of households with supposed access buy it; but this is up from 17% just three years ago.

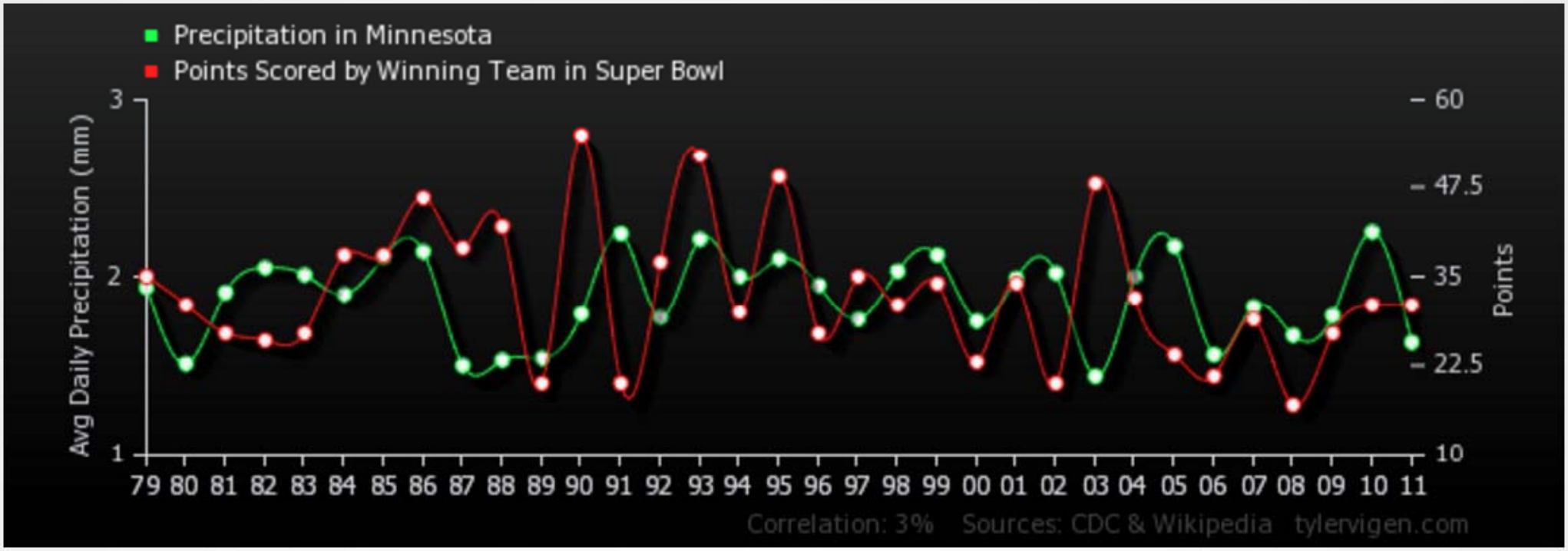
We are mindful of possibly spurious statistical associations

Marriage rate in Minnesota
inversely correlates with
Lawyers in Delaware

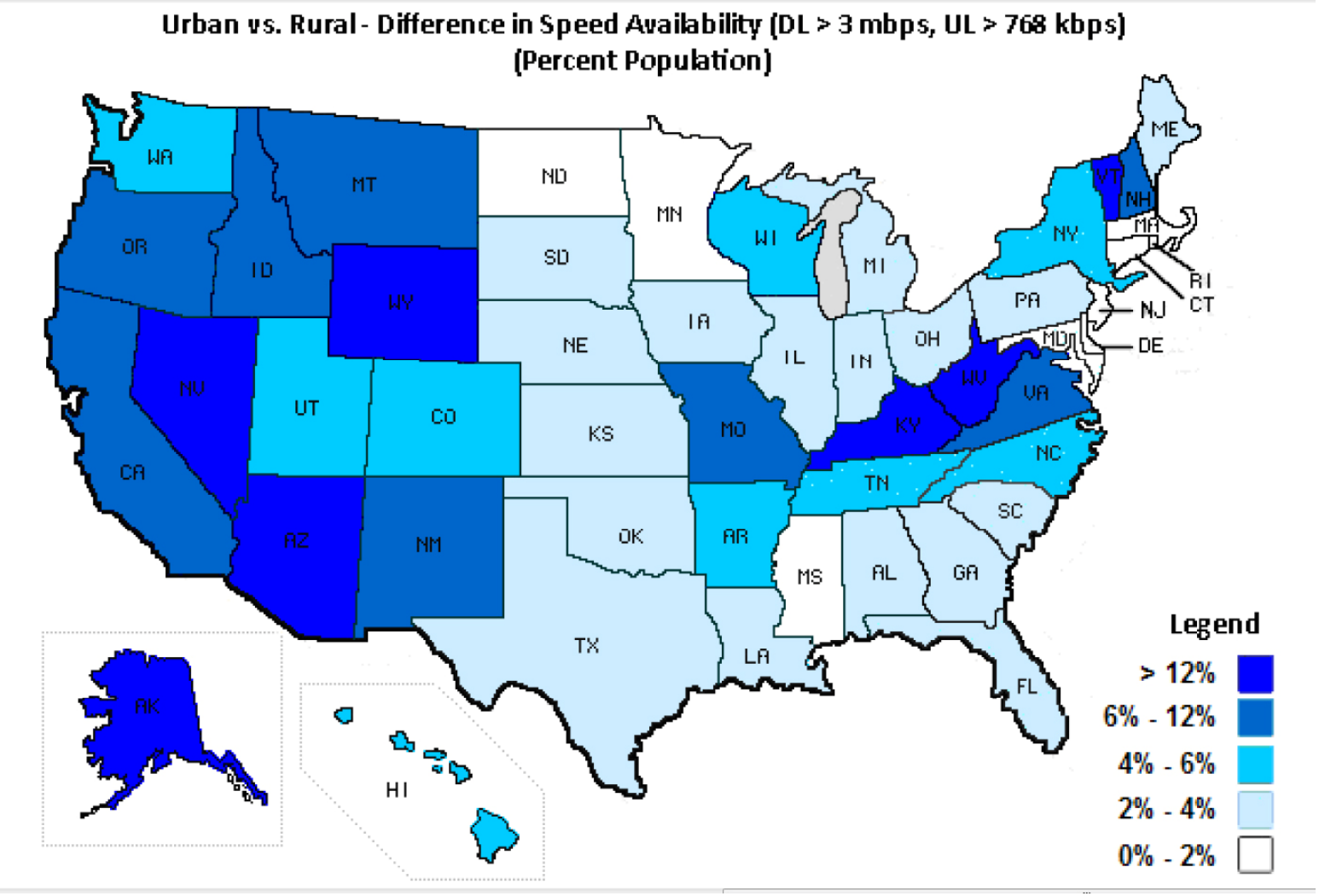


… and one more

Precipitation in Minnesota
correlates with
Points Scored by Winning Team in Super Bowl



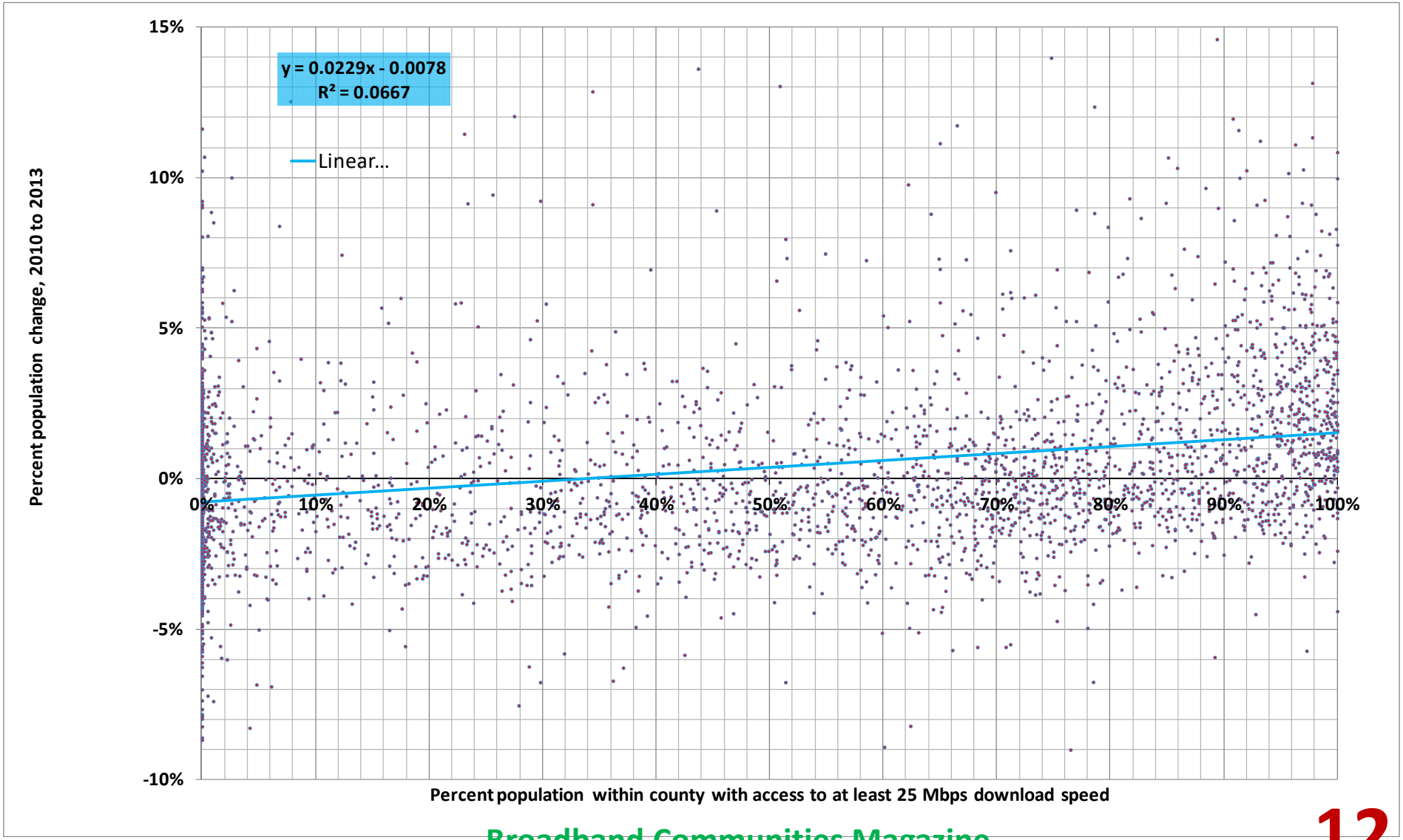
But no matter the speed, there is a divide; this NTIA map shows divide at 3 Mbps



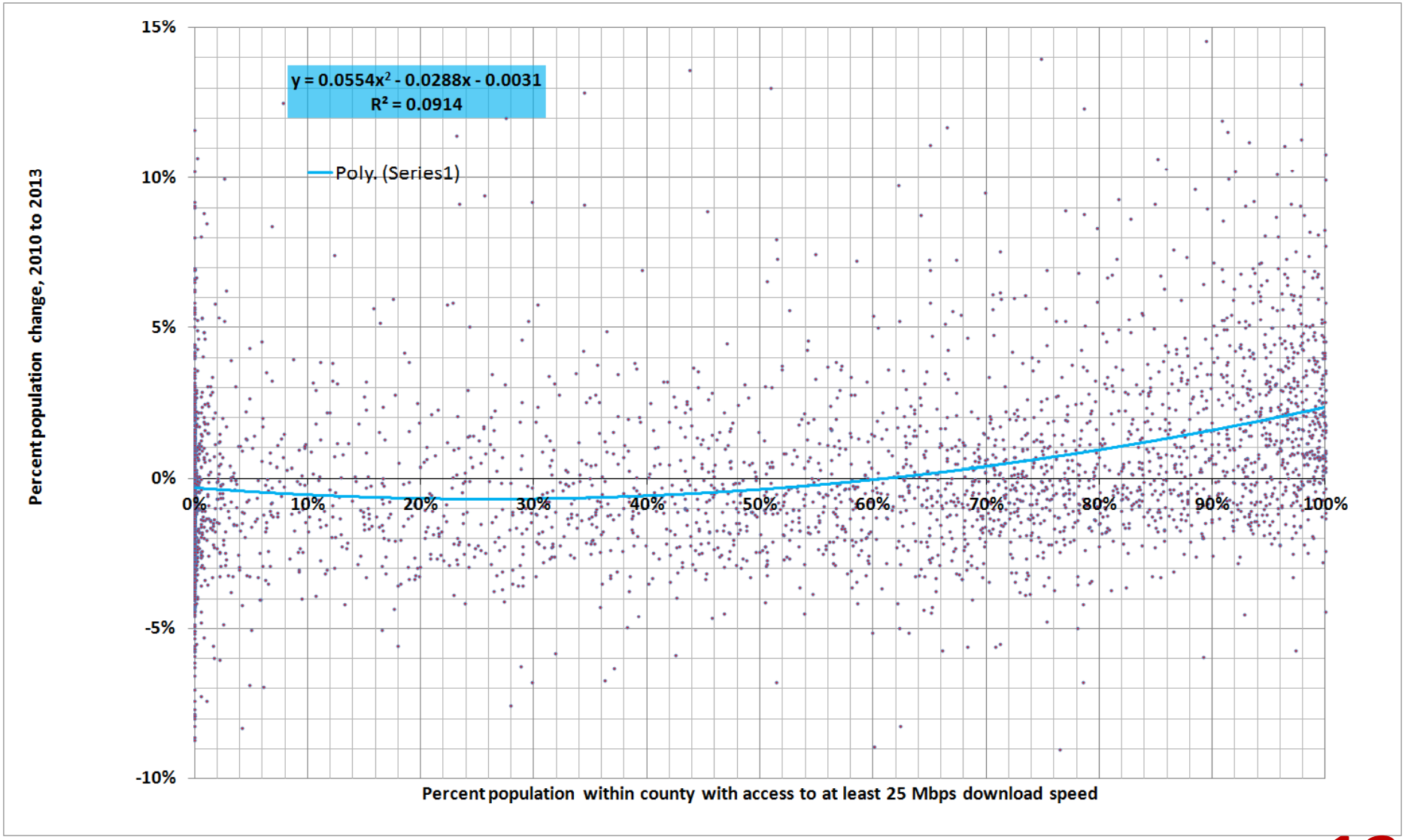
In the Broadband Communities "overview" scatterplots (in the next two slides):

- Each dot is a county. Populations range from a few dozen people to over 2 million. All the dots are the same size.
- Outliers (highest and lowest Y values) are not on the charts (for clarity) but are used in the calculations.
- Linear best fit has X-intercept (goes negative population growth) at 35% access; second-order polynomial intercept is at 60% access. If we weight the dots by their true population size, r^2 goes up a lot, intercepts move down a bit.
- Unlikely to be a spurious association because n=3144, not 10 or 20 as in earlier charts. But confounders don't go away even if n is very, very, large. Something unknown could be going on. New USDA data has reduced the chance of an unknown effect.
- Remember the issue of causality…

Access to broadband clearly associated with population change



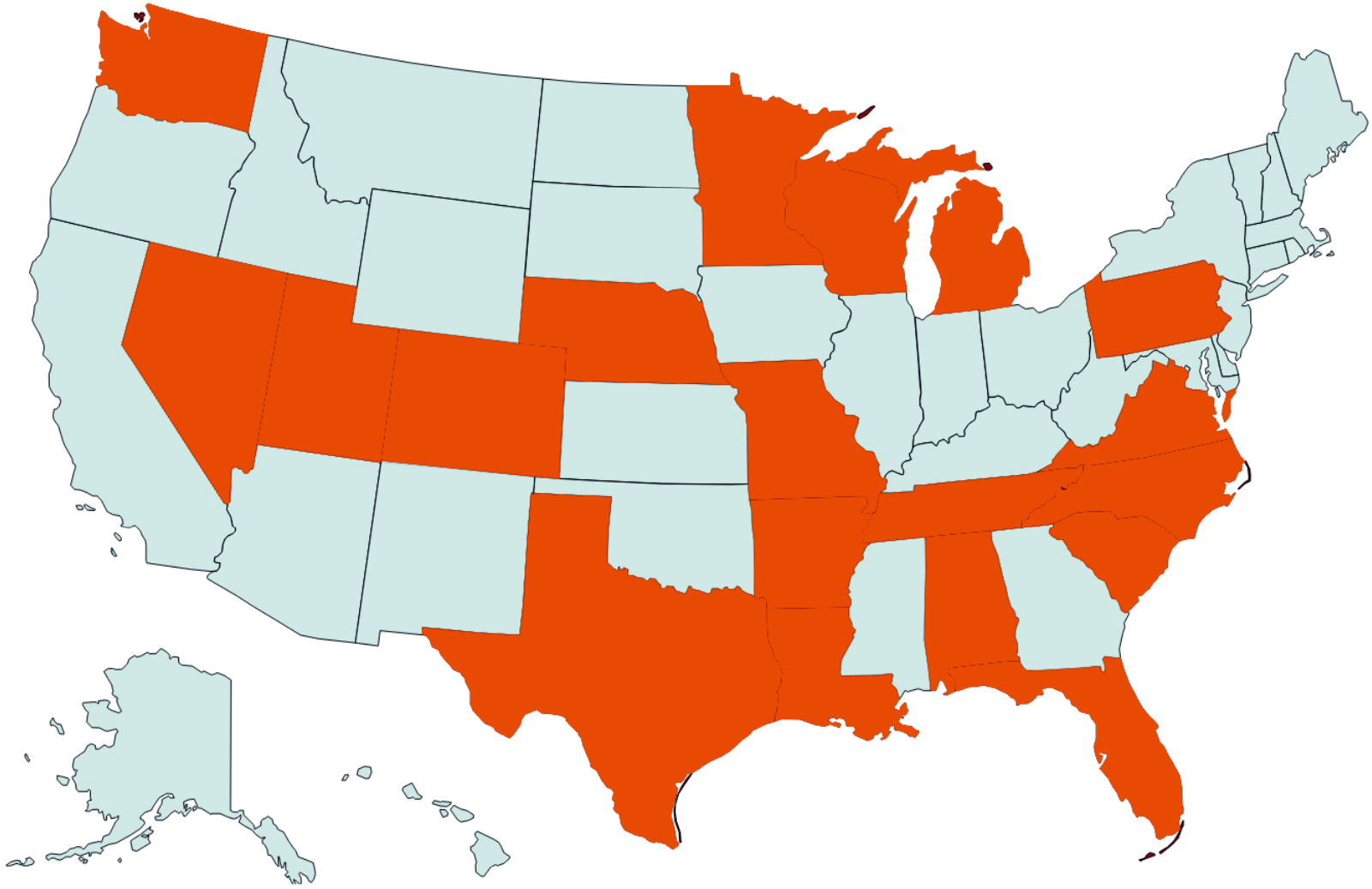
The polynomial fit has better r^2 and also much later x-intercept

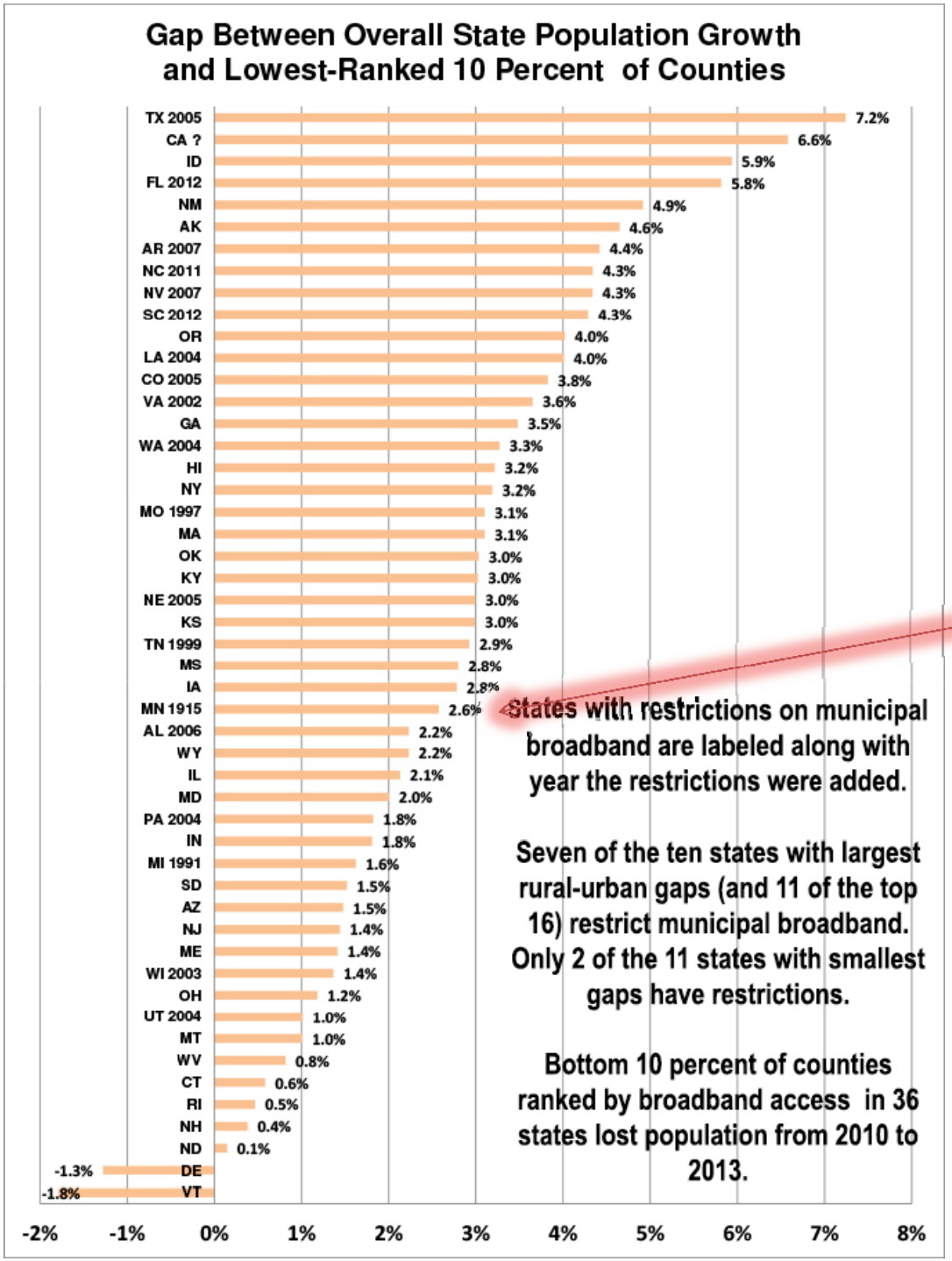


For all states, the pattern is consistent except for tiny, lowest-ranked counties (upper green cell in table)

County Rank Within State	2010 population	2013 population	Population change	Percent change
Bottom 10%	5,420,347	5,390,628	(29,776)	-0.55%
Top 10%	131,229,210	135,396,793	4,167,583	3.18%
Bottom half	49,586,078	49,720,525	134,390	0.27%
Top half	258,559,871	265,761,865	7,201,994	2.79%
Bottom	1,318,114	1,322,720	4,549	0.35%
Top	31,225,768	32,351,828	1,126,060	3.61%

Causality validation test: States with muni restrictions are mainly high-growth overall, but their rural counties lag non-restriction states

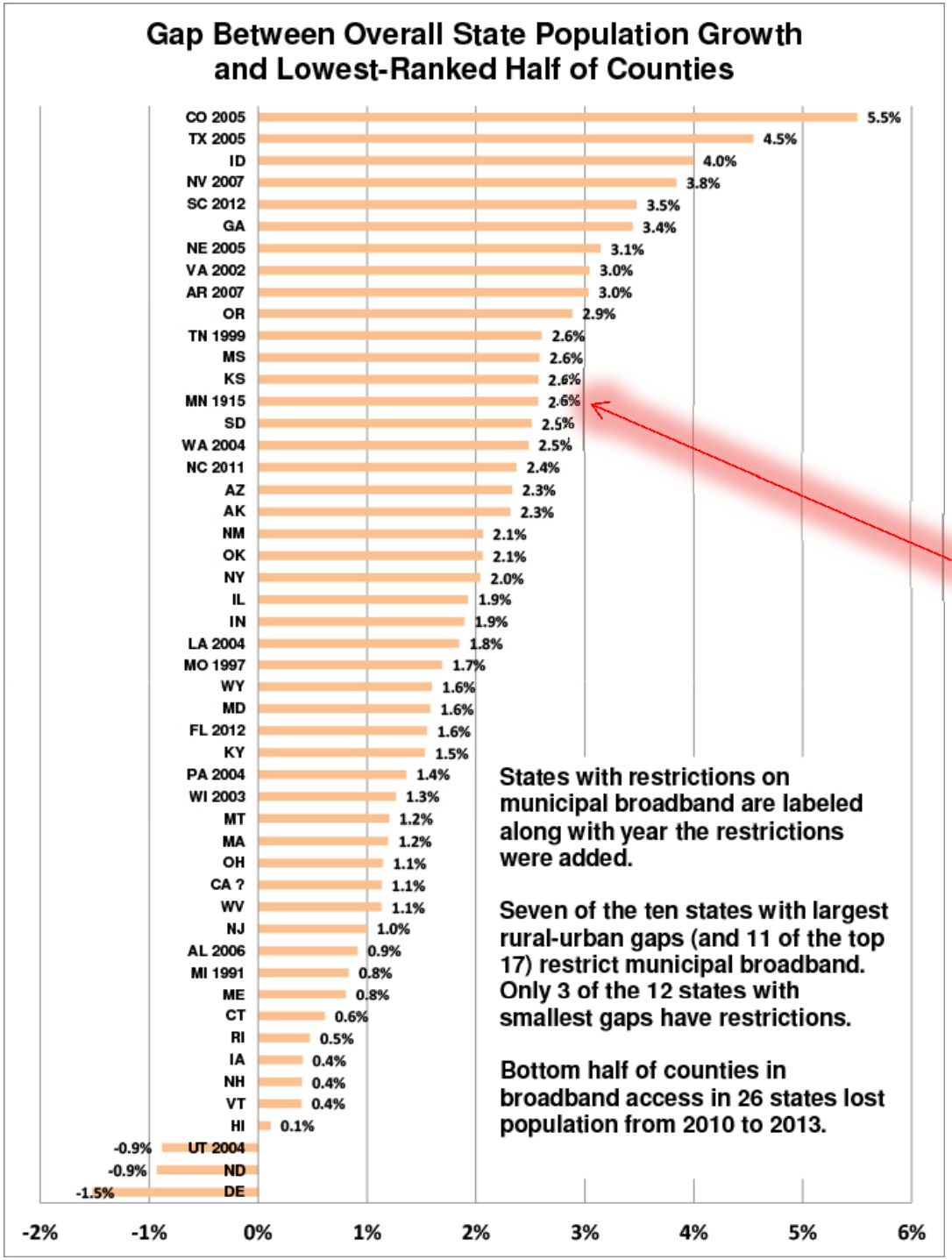




Gap by state All counties vs lowest 10%

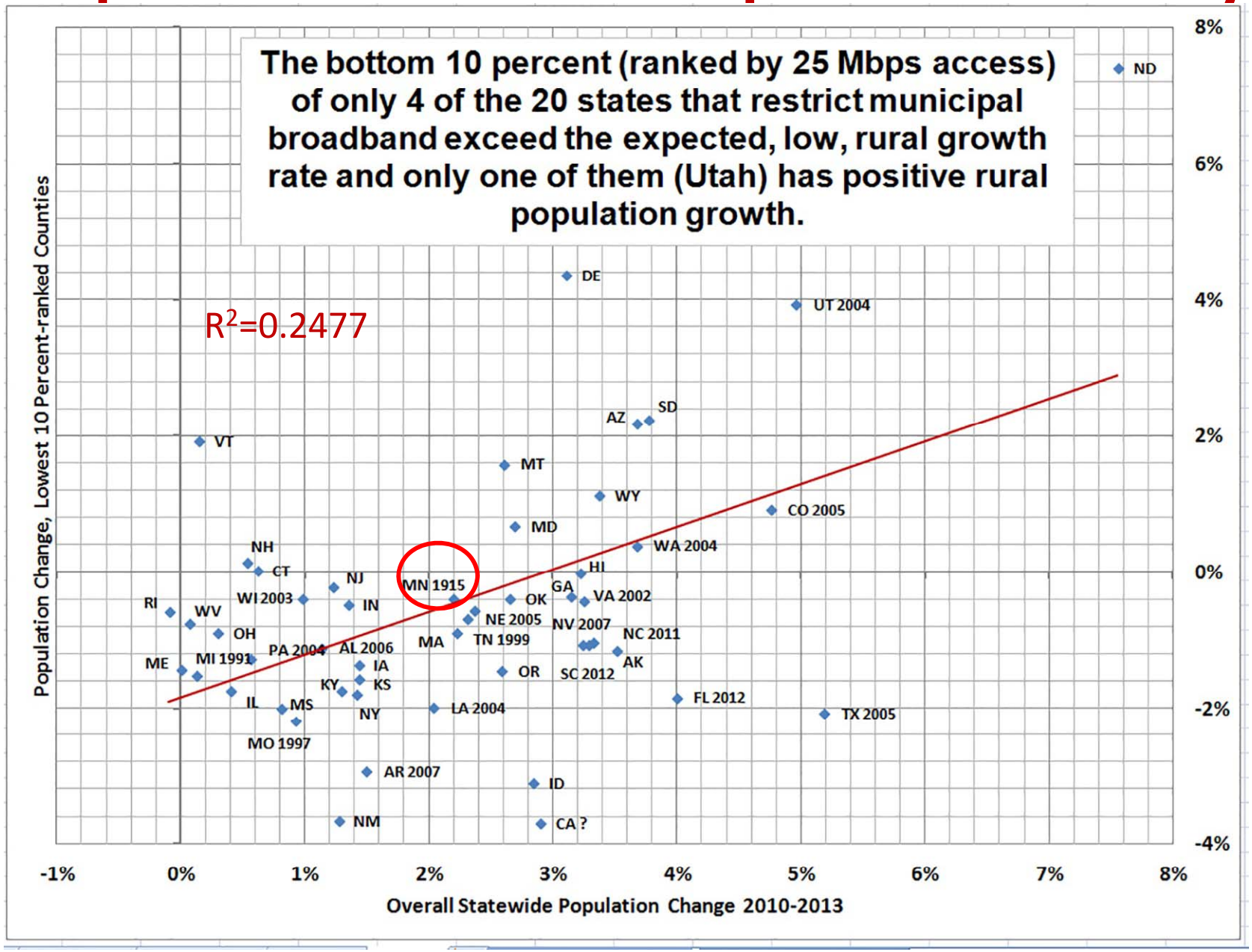
Always room for improvement: MN has slightly Lower rich-poor county gap than national average. that is, its counties ranked low in broadband access are not THAT far behind the state norm.

Gap by state
All counties
vs lowest half

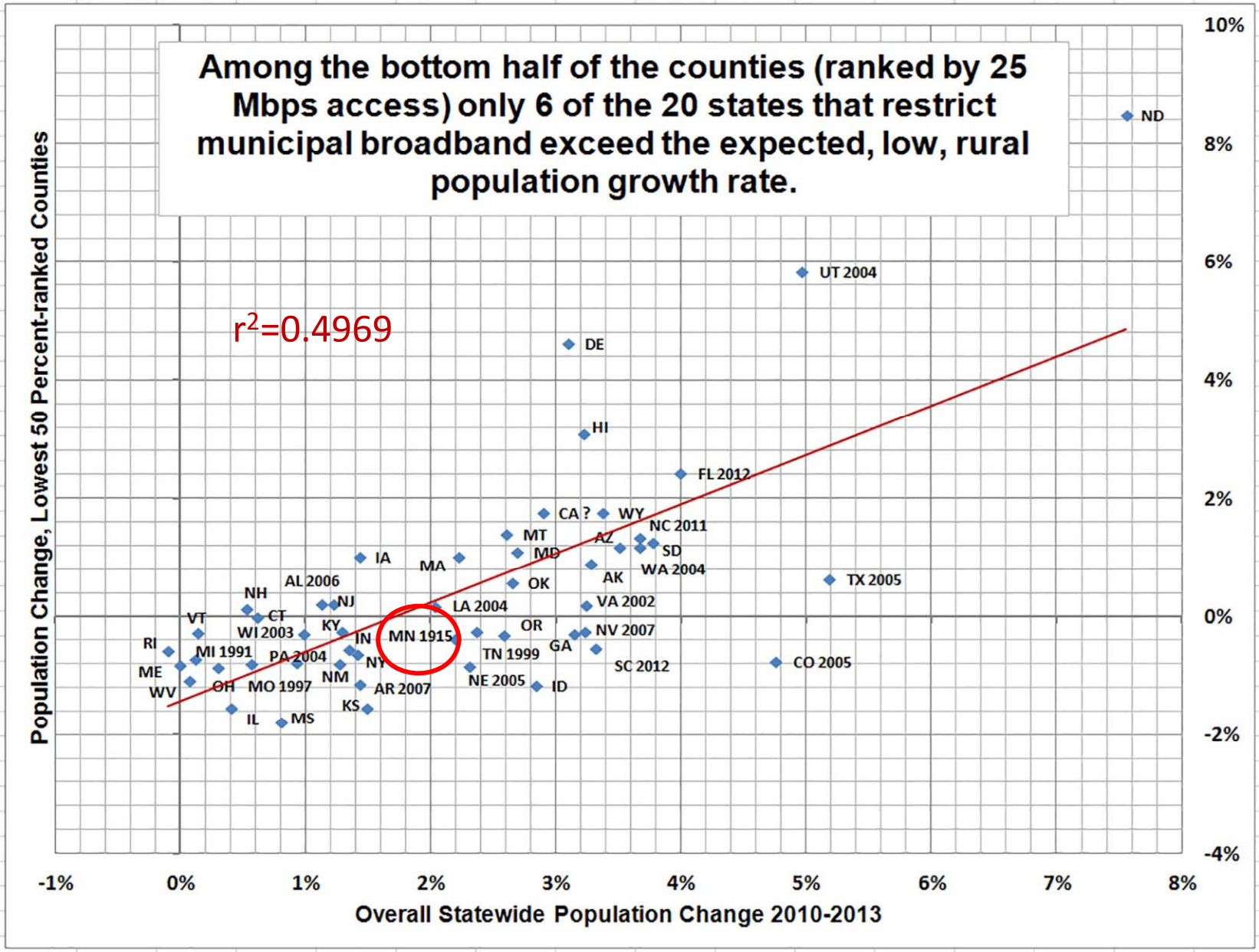


MN has higher-than-Average overall rich-poor county gap than national Average. That is, the bottom half of counties are on average pretty low on access.

MN has same population growth in poorest counties as expected nationally



…but MN growth overall is well below the national trendline with better r^2



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States that restrict muni broadband, or don't

Rural counties in states that restrict municipal broadband have biggest rural-urban divide and lower rural growth despite greater growth in top-ranked counties; the "haves" steal growth from the "have-nots."

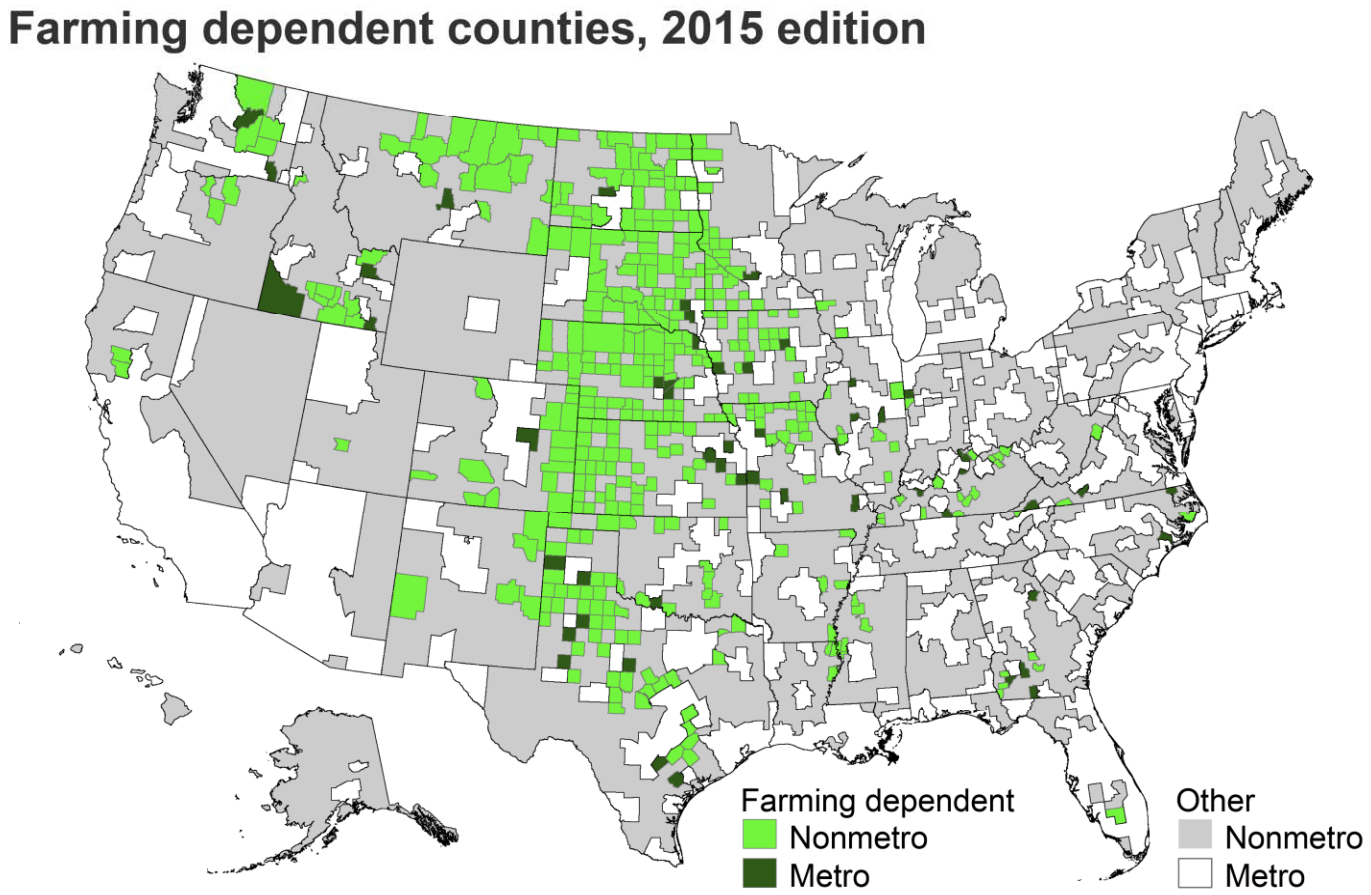
This would be an unlikely outcome if overall national relationship were spurious. HOW unlikely is tricky because not all restrictions are the same. Also, the first has been in place for 100 years, the most recent is a year old. Some consider California to be a "restriction" state; we don't, yet. Comparing restriction vs non-restriction states suggests less than 1 chance in 100 of spurious association. Closer look at different economic bases in counties confirms that.

Muni Broadband Restricted	2010 population	2013 population	Population change	Percent change
Restricted*	143,206,350	147,385,511	4,179,161	2.92%
Not restricted	165,541,366	168,743,328	3,201,962	1.93%
All USA counties	308,747,716	316,128,839	7,381,123	2.39%
Restricted, top half	123,001,244	127,133,430	4,132,186	3.36%
Restricted, bottom half	20,205,106	20,252,081	46,975	**0.23%**
Not restricted, top half	135,558,627	138,628,435	3,069,808	2.26%
Not restricted, bottom half	29,380,972	29,468,444	87,472	**0.30%**
Restricted, top 10%	61,690,676	64,076,565	2,385,889	3.87%
Restricted, bottom 10%	2,090,415	2,069,461	(20,954)	**-1.00%**
Not restricted, top 10%	69,538,534	71,320,228	1,781,694	2.56%
Not restricted, bottom 10%	3,329,932	3,321,167	(8,765)	**-0.26%**

Splits by county Type

- USDA classifies counties by their dominant activities – farming, mining, recreation, retirement, manufacturing, government installations (everything from state capitals to military bases).
- The pattern holds for almost all county types.
- USDA data is also a bridge to income – poverty rates and childhood poverty are measured every 3 or 4 years.
- Latest USDA splits were issued in December 2015 and corrected in June 2016.

Farming



Farming dependent counties are those where 25 percent or more of the county's average annual labor and proprietors' earnings were derived from farming, or 16 percent or more of jobs were in farming, as measured by 2010-12 Bureau of Economic Analysis, Local Area Personal Income and Employment data.
Note that county boundaries are drawn for the farming dependent counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis.

Farming

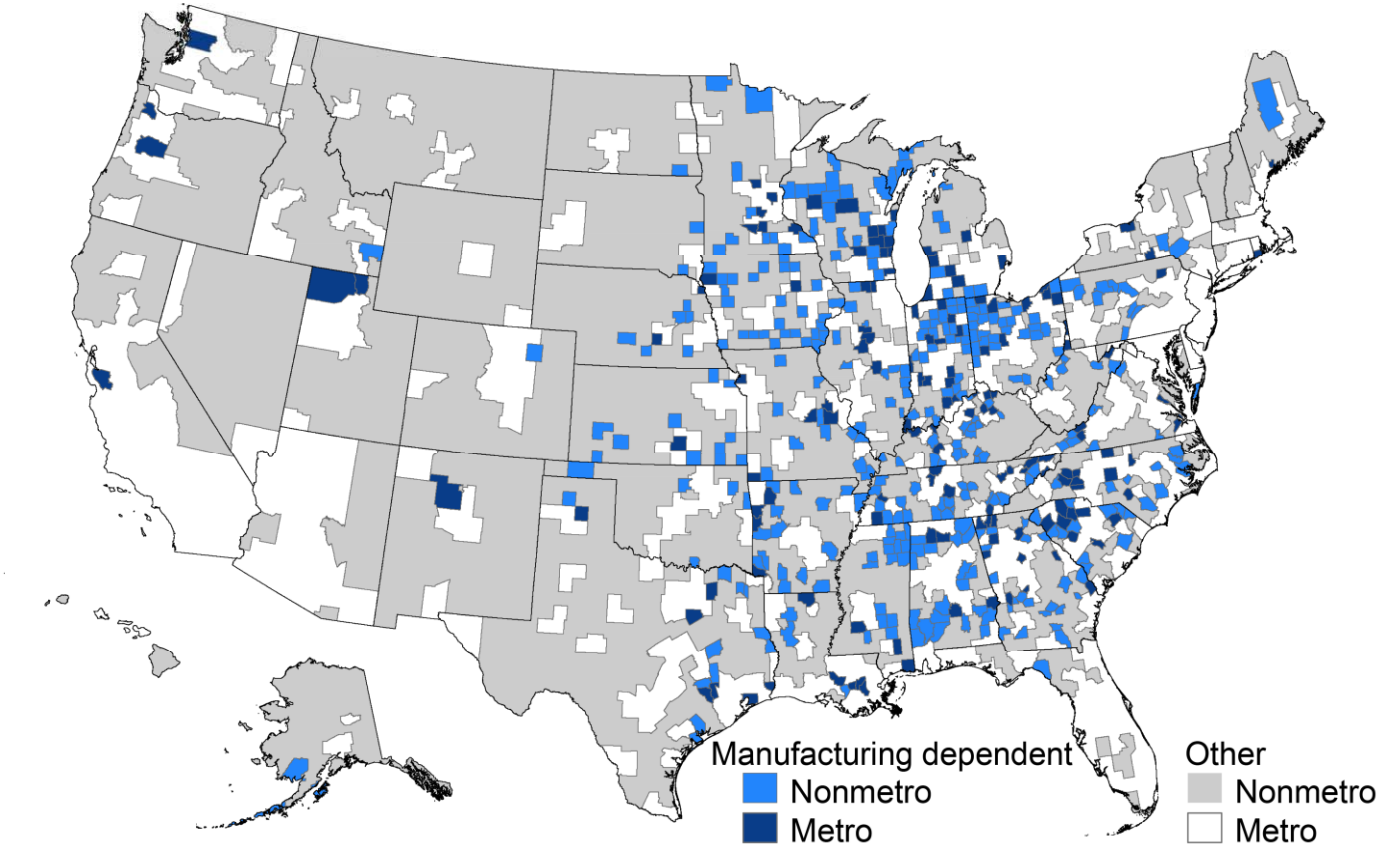
Farming	2010 population	2013 population	Population change	% population change
In a restricted state (231)	2,004,621	1,986,540	(18,081)	-0.90%
In an open state (276)	1,969,859	1,960,906	(8,953)	-0.45%
Broadband access within-state rank				
Restricted, top half (60)	638,728	639,714	986	0.15%
Restricted, bottom half (170)	1,365,893	1,346,826	(19,067)	-1.40%
Not restricted, top half (97)	776,465	775,775	(690)	-0.09%
Not restricted, bottom half (181)	1,193,394	1,185,131	(8,263)	-0.69%
Restricted, top 10% (2)	28,454	28,802	348	1.22%
Restricted, bottom 10% (45)	199,975	197,521	(2,454)	-1.23%
Not restricted, top 10% (9)	35,812	35,766	(46)	-0.13%
Not restricted, bottom 10% (52)	258,878	256,361	(2,517)	-0.97%

Agriculture-dependent counties in states that restrict municipal or broadband provided by other quasi-public entities such as electric coops, lost population at Twice the rate of similar counties in “non-restriction” states.

Number of counties in each row sample is listed in (parentheses)

Manufacturing

Manufacturing dependent counties, 2015 edition



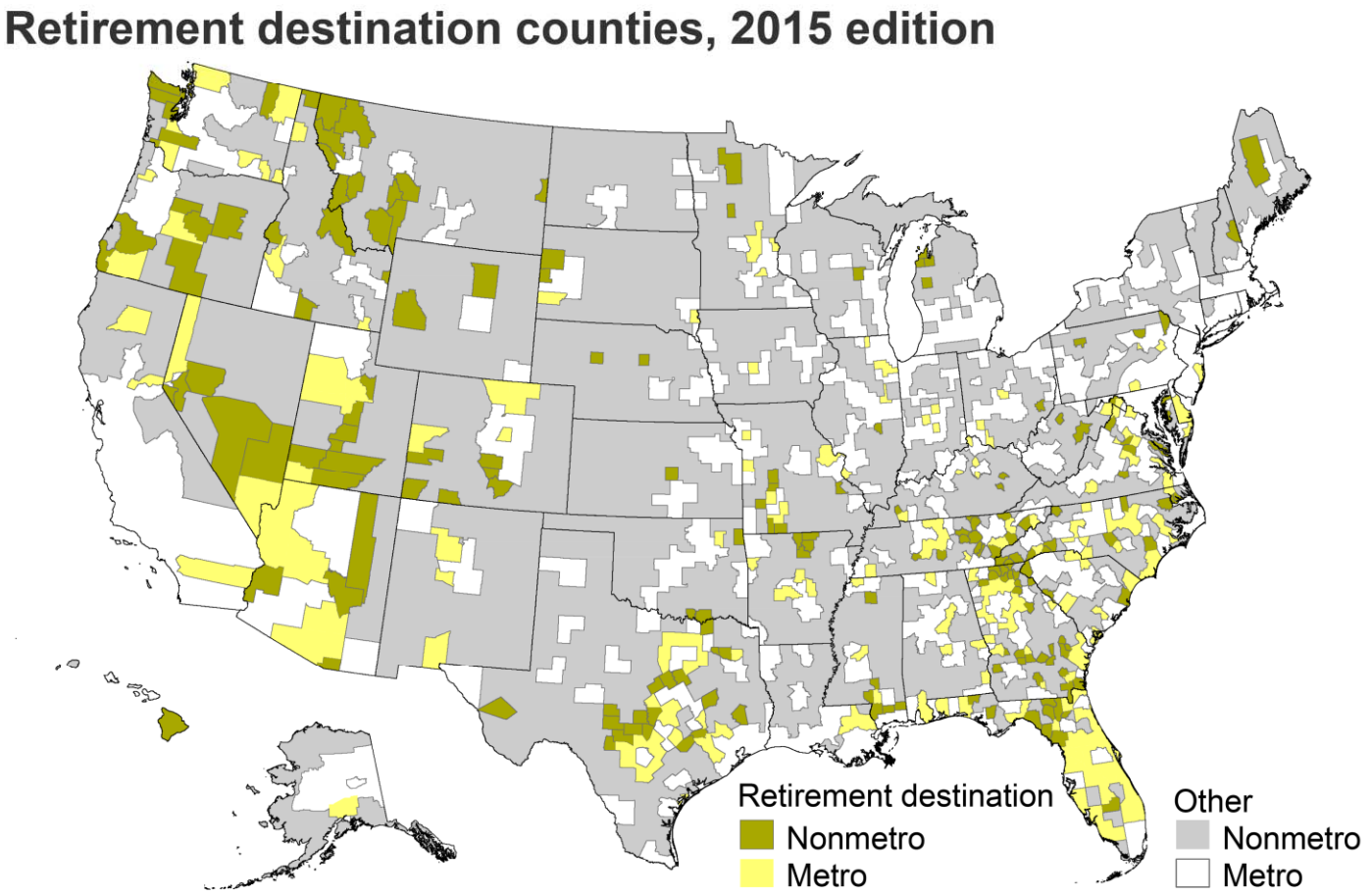
Manufacturing dependent counties are those where 23 percent or more of the county's average annual labor and proprietors' earnings were derived from manufacturing, or 16 percent or more of jobs were in manufacturing, as measured by 2010-12 Bureau of Economic Analysis, Local Area Personal Income and Employment data.
Note that county boundaries are drawn for the manufacturing dependent counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis.

Manufacturing

Manufacturing	2010 population	2013 population	Population change	% population change
In a restricted state (259)	13,880,061	14,008,301	128,240	0.92%
In an open state (257)	12,503,396	12,632,139	128,743	1.03%
Broadband access within-state rank				
Restricted, top half (137)	10,353,384	10,497,425	144,041	1.39%
Restricted, bottom half (122)	3,526,677	3,510,876	(15,801)	-0.45%
Not restricted, top half (124)	9,112,360	9,259,263	146,903	1.61%
Not restricted, bottom half (133)	3,391,036	3,372,876	(18,160)	-0.54%
Restricted, top 10% (26)	3,754,956	3,828,167	73,211	1.95%
Restricted, bottom 10% (15)	392,321	388,953	(3,368)	-0.86%
Not restricted, top 10% (14)	2,321,172	2,356,376	35,204	1.52%
Not restricted, bottom 10% (23)	500,969	498,248	(2,721)	-0.54%

There is clear evidence that broadband helps, and that a lot of broadband helps more. But in these counties with generally higher population densities than agricultural counties, the private sector makes up most of the gaps. Still, manufacturing counties grow at considerably less than half the rate of the national average. Number of counties in each row sample is listed in (parentheses)

Retirement



Retirement destination counties are those where the number of residents age 60 and older grew by 15 percent or more between the 2000 and 2010 censuses due to net migration. Note that county boundaries are drawn only for the retirement destination counties. Source: USDA, Economic Research Service using data from U.S. Census Bureau.

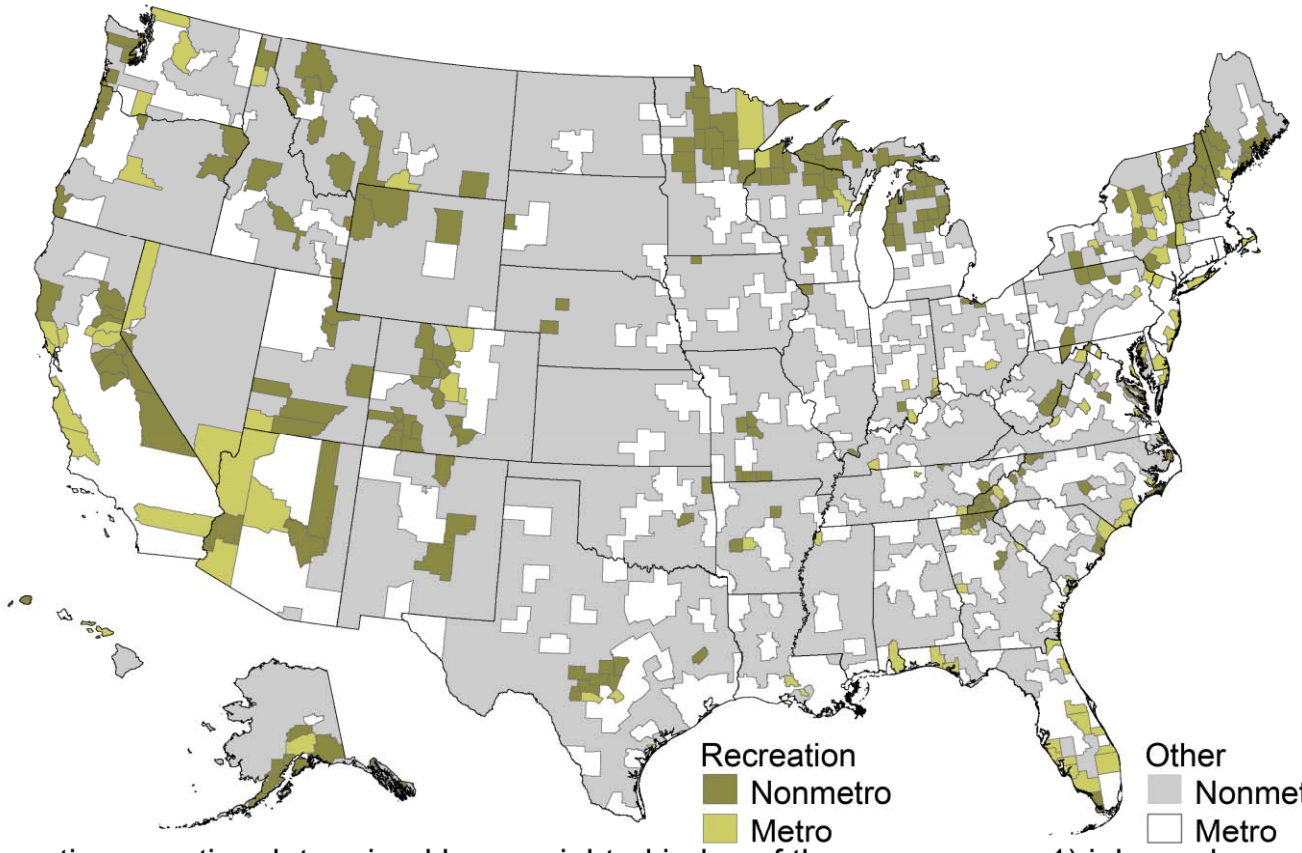
Retirement

Retirement	2010 population	2013 population	Population change	% population change
In a restricted state (280)	31,050,745	32,492,039	1,441,294	4.64%
In an open state (162)	14,468,260	14,943,636	475,376	3.29%
Broadband access within-state rank				
Restricted, top half (158)	25,939,320	27,267,991	1,328,671	5.12%
Restricted, bottom half (122)	5,111,425	5,224,048	112,623	2.20%
Not restricted, top half (86)	11,111,846	11,520,355	408,509	3.68%
Not restricted, bottom half (76)	3,356,414	3,423,281	66,867	1.99%
Restricted, top 10% (31)	10,780,060	11,422,443	642,383	5.96%
Restricted, bottom 10% (24)	568,350	564,842	(3,508)	-0.62%
Not restricted, top 10% (16)	3,560,651	3,698,003	137,352	3.86%
Not restricted, bottom 10% (9)	252,186	258,485	6,299	2.50%

Retirement communities are overwhelmingly in southern states that restrict public broadband. The only retirement counties that are NOT growing are in “restriction” states and have particularly poorly ranked broadband access. But where private carriers can make a good economic case, great broadband leads to extraordinary growth rates. Number of counties in each row listed in (parentheses)

Recreation

Recreation counties, 2015 edition



Recreation counties determined by a weighted index of three measures: 1) jobs and 2) earnings in the following: entertainment, recreation, accommodations, eating/drinking places, and real estate; and 3) the share of vacant housing units intended for seasonal/occasional use. Recreation counties are those with a score more than one deviation above the mean.
Note that county boundaries are drawn for the recreation counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis and U.S. Census Bureau.

Recreation

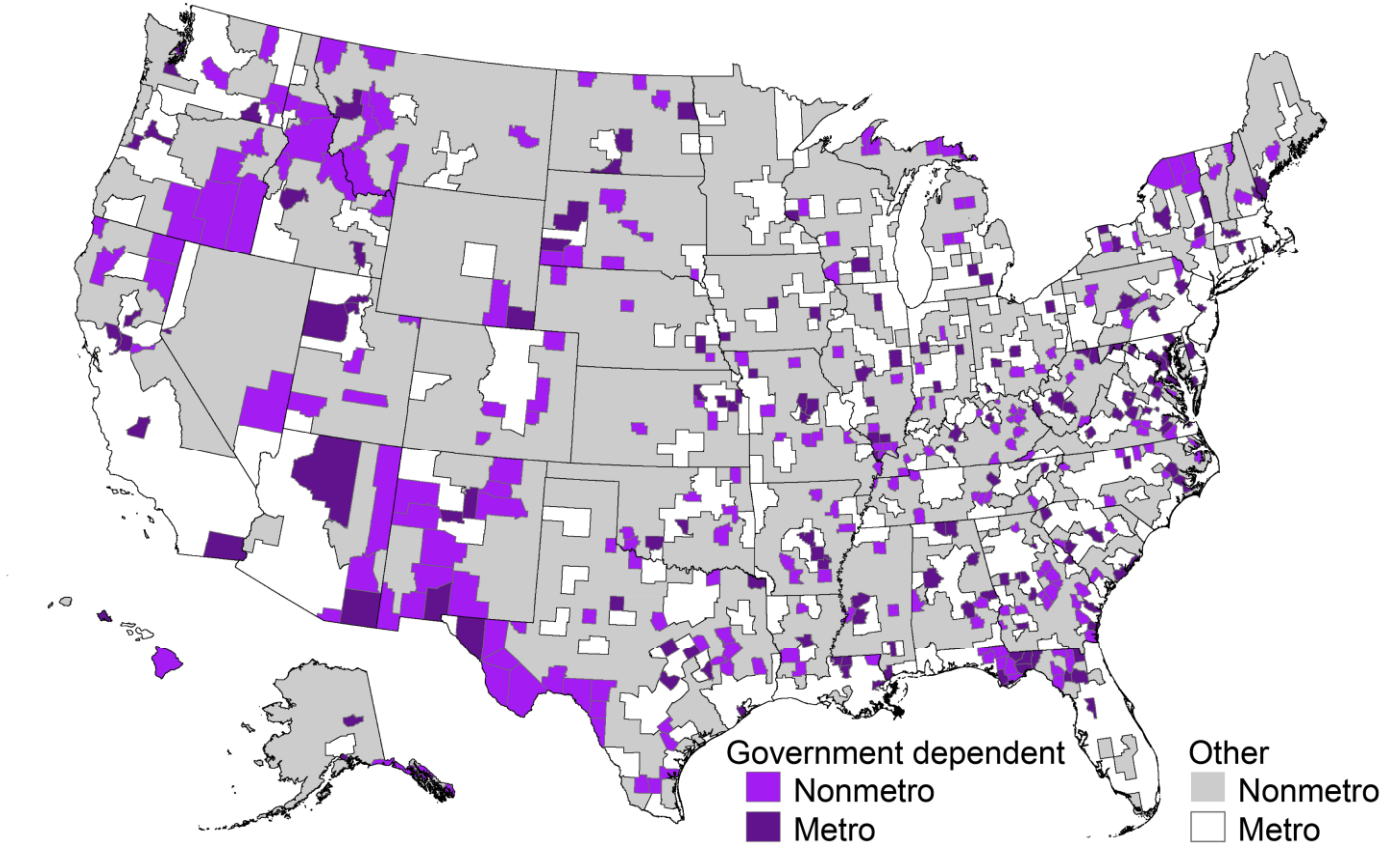
Recreation	2010 population	2013 population	Population change	% population change
In a restricted state (231)	14,917,089	15,457,630	540,541	3.62%
In an open state (197)	15,840,824	16,120,221	279,397	1.76%
Broadband access within-state rank				
Restricted, top half (112)	12,108,402	12,597,613	489,211	4.04%
Restricted, bottom half (119)	2,808,687	2,860,017	51,330	1.83%
Not restricted, top half (67)	9,304,658	9,525,512	220,854	2.37%
Not restricted, bottom half (130)	6,536,166	6,594,709	58,543	0.90%
Restricted, top 10% (7)	5,054,809	5,297,011	242,202	4.79%
Restricted, bottom 10% (28)	430,245	425,800	(4,445)	-1.03%
Not restricted, top 10% (8)	1,872,049	1,918,242	46,193	2.47%
Not restricted, bottom 10% (33)	1,058,591	1,055,526	(3,065)	-0.29%

Counties that draw tourists in are about evenly split between restriction and non-restriction states. On average, these counties tend to have pretty good broadband. But when they don't (those counties ranking in the lowest 10%), restriction states suffer more than three times worse.

Number of counties in each row sample is listed in (parentheses)

Government

Federal/State government dependent counties, 2015 edition



Government dependent counties are those where 14 percent or more of the county's average annual labor and proprietors' earnings were derived from Federal/State government, or 9 percent or more jobs were in Federal/State government as measured by 2010-12 Bureau of Economic Analysis, Local Area Personal Income and Employment data.
Note that county boundaries are drawn for the government dependent counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis.

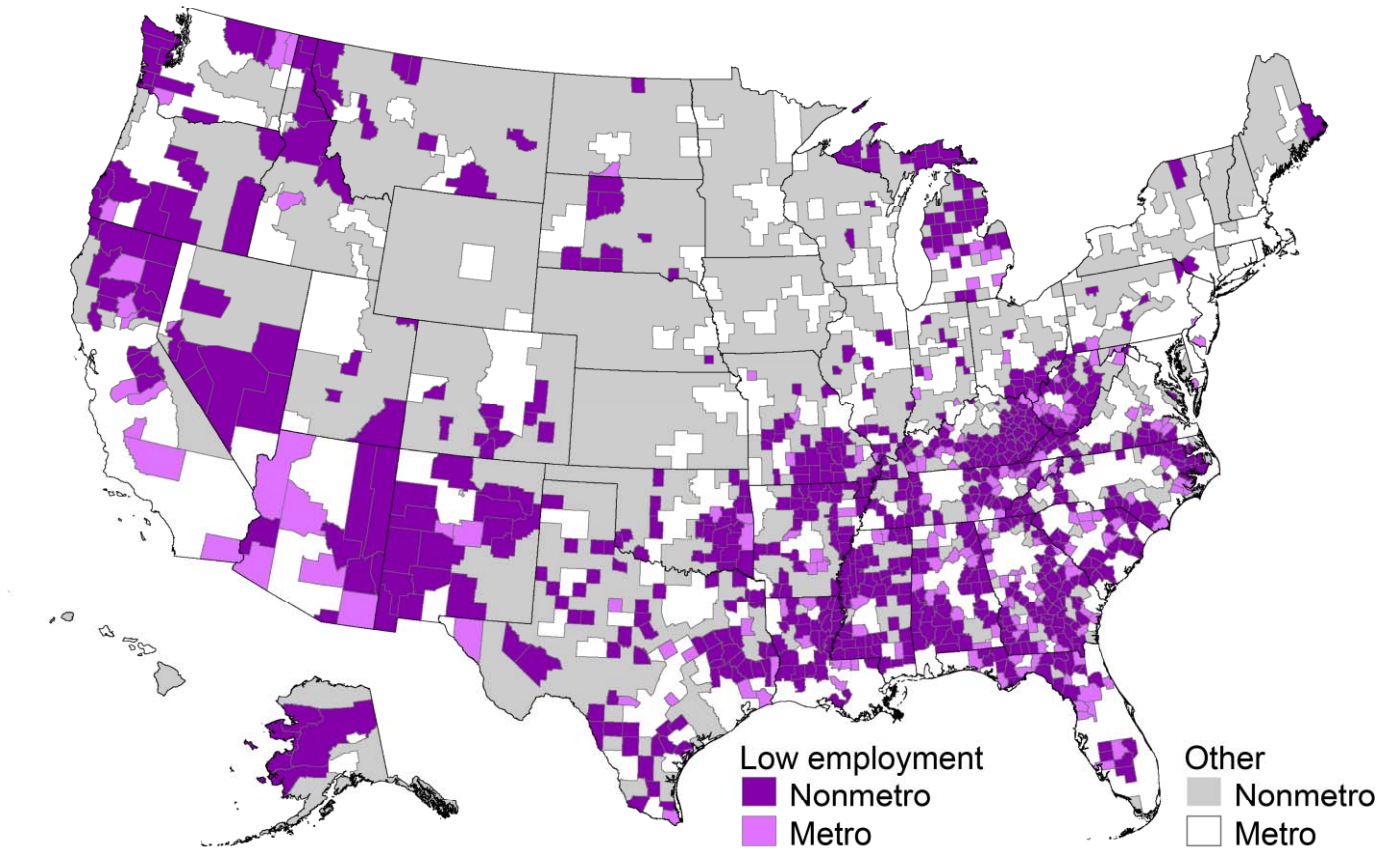
Government

Government	2010 population	2013 population	Population change	% population change
In a restricted state (225)	15,180,226	15,604,517	424,291	2.80%
In an open state (236)	22,418,610	22,920,293	501,683	2.24%
Broadband access within-state rank				
Restricted, top half (99)	11,642,087	12,052,545	410,458	3.53%
Restricted, bottom half (126)	3,538,139	3,551,972	13,833	0.39%
Not restricted, top half (122)	17,562,001	18,014,372	452,371	2.58%
Not restricted, bottom half (113)	4,254,886	4,259,472	4,586	0.11%
Restricted, top 10% (20)	3,128,608	3,228,023	99,415	3.18%
Restricted, bottom 10% (24)	354,188	349,526	(4,662)	-1.32%
Not restricted, top 10% (30)	7,411,604	7,649,954	238,350	3.22%
Not restricted, bottom 10% (27)	524,520	528,179	3,659	0.70%

Counties dominated by government-supported activities follow the same pattern – really bad broadband in restriction states, will cause population loss. But here, cause and effect may be muddled. Restriction states were also more likely to cut public employment and salaries during the recession. Number of counties in each row sample is listed in (parentheses)

Low employment

Low employment counties, 2015 edition



Low employment counties are those where less than 65 percent of county residents age 25-64 were employed, determined by the American Community Survey 5-year average data for 2008-12.
Note that county boundaries are drawn for the low employment counties only.
Source: USDA, Economic Research Service using data from U.S. Census Bureau.

Low employment

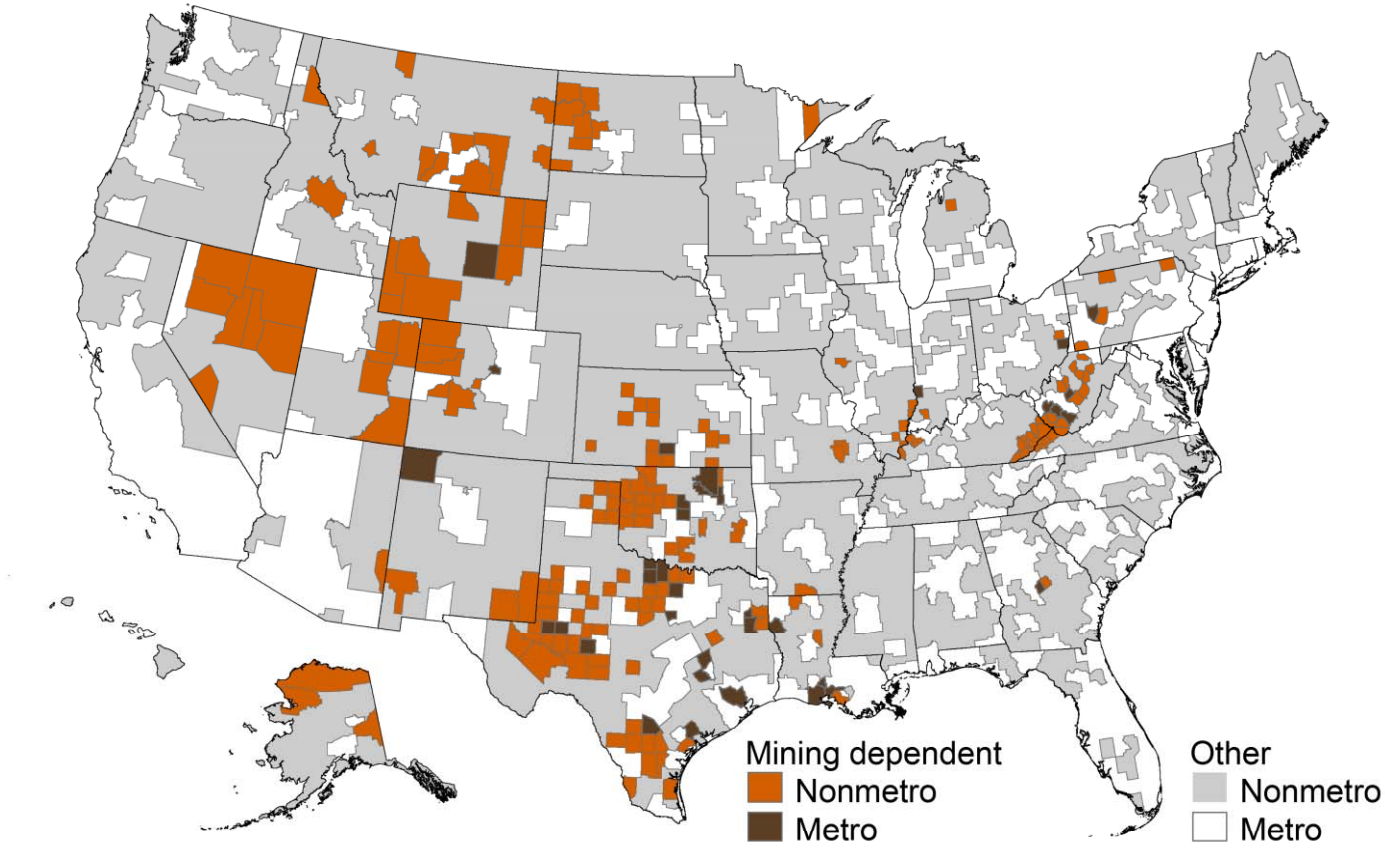
Low employment	2010 population	2013 population	Population change	% population change
In a restricted state (485)	19,471,765	19,416,268	(55,497)	-0.29%
In an open state (421)	14,490,585	14,502,782	12,197	0.08%
Broadband access within-state rank				
Restricted, top half (145)	10,597,072	10,585,689	(11,383)	-0.11%
Restricted, bottom half (340)	8,874,693	8,830,579	(44,114)	-0.50%
Not restricted, top half (142)	7,082,731	7,113,425	30,694	0.43%
Not restricted, bottom half (279)	7,407,854	7,389,357	(18,497)	-0.25%
Restricted, top 10% (10)	4,175,741	4,145,912	(29,829)	-0.71%
Restricted, bottom 10% (68)	1,234,213	1,217,241	(16,972)	-1.38%
Not restricted, top 10% (5)	494,287	494,912	625	0.13%
Not restricted, bottom 10% (56)	1,002,083	1,001,582	(501)	-0.05%

Populations grew significantly faster or declined more slowly in states that did not Restrict public or quasi-public broadband, all through the recession.

Number of counties in each row sample is listed in (parentheses)

Mining

Mining dependent counties, 2015 edition



Mining dependent counties are those where 13 percent or more of the county's average annual labor and proprietors' earnings were derived from mining, or 8 percent or more of jobs were in mining, as measured by 2010-12 Bureau of Economic Analysis, Local Area Personal Income and Employment data.
Note that county boundaries are drawn for the mining dependent counties only.
Source: USDA, Economic Research Service using data from Bureau of Economic Analysis.

Mining

Mining	2010 population	2013 population	Population change	% population change
In a restricted state (124)	7,094,357	7,401,512	307,155	4.33%
In an open state (132)	3,826,302	3,906,269	79,967	2.09%
Broadband access within-state rank				
Restricted, top half (48)	5,914,083	6,205,245	291,162	4.92%
Restricted, bottom half (61)	1,103,752	1,120,240	16,488	1.49%
Not restricted, top half (50)	2,021,801	2,076,633	54,832	2.71%
Not restricted, bottom half (65)	931,410	933,772	2,362	0.25%
Restricted, top 10% (9)	4,695,883	4,971,328	275,445	5.87%
Restricted, bottom 10% (18)	79,650	79,325	(325)	-0.41%
Not restricted, top 10% (8)	1,560,691	1,626,323	65,632	4.21%
Not restricted, bottom 10% (15)	137,079	136,226	(853)	-0.62%

Mining counties are the only ones where the pattern did not hold. There have been enormous economic and technical forces at work in this sector, and they dwarf anything most states can do or not do. Canada, more reliant on mining than is the USA, has suffered even more as raw materials prices have fallen.

Number of counties in each row sample is listed in (parentheses)

To summarize:

- States that restrict muni broadband have been growing faster since 2010 – **2.92% vs 1.93%**
- But that growth is concentrated in high access counties (Bottom half of "restriction" states grew only **0.23% since 2010, vs 0.30%**)
- Difference widens as we move to counties ranked in lowest 10% in their states (**-1.00% since 2010 in "restriction" states, vs -0.26%**)
- Segmenting the data by dominant type of economic activity in each county confirms the overall pattern and much of the causality – lack of broadband causes more loss of population, rather than low population discouraging broadband.

Why does this happen?

- Municipalities don't really want to build their own modern systems; about 200 muni fiber systems have been built. There are 40,000 communities in the USA, more than 15,000 large enough to have their own school system.
- Municipalities in 30 states can THREATEN to build their own systems, sometimes leading to grudging upgrades.
- States that don't even allow threatening essentially doom these communities so that ISPs, usually large, can milk old "outside plant."

So what do we do? Support muni and public-private broadband partnerships

- Nationally, there are about 50 premises per road mile (130+ million premises, 2.7 million miles of paved road).
- Rural areas of course have far fewer.
- Wall Street says fiber to fewer than 30 per mile (minimum 12-15 actual customers) can't compete for capital.
- But a municipality can break even at 8-10 customers per mile if ARPU throws off $40-50 a month profit before overheads – about $150 gross a month.
- Rural communities tend to get higher take rates and lower churn, so the commercial business case can work at well under 20 premises per mile.
- Old outside plant can't get that ARPU because the old plant can't support it.
- **The models are clear – the big Wall Street-funded carriers would do better by having communities, or Tier3 LECs, build new plant that the big guys can rent, to offer great services and gain revenue. Wall Street hates uncertainty, so big firms have been spinning off rural or near-rural holdings. RBOCs are already spinning off assets they would rather rent than own – cell towers, for example.**

What can we at Broadband Communities do?

- Continue analyzing the data, no matter where that leads (we're not in the business of putting our readers out of business). Expect new revelations every issue.
- I'm adding USGS data to the mix to check customers per road mile, and also looking at state-by-state growth records.
- Push for public policy refinements at the state level.
- In broad outline, support policy changes being pushed by FCC and the White House.

Q&A

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- The first article in this series was a finalist for best original research by a business magazine, in the national American Society of Business Publication Editors competition. It won first place in ASBPE's Northeast Region, which includes NY, NJ, CT etc. The second article won a regional second place award. The third will be published next month.